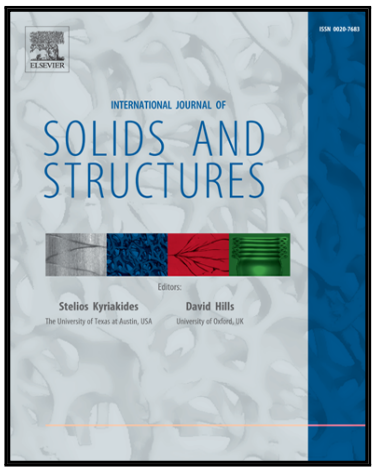

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Micromechanical Finite Element Analysis of the Effects of Martensite Morphology on the Overall Mechanical Behavior of Dual Phase Steel

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HIGHLIGHTS

- Virtually generated realistic microstructures of Dual Phase steels are simulated
- Effect of martensite morphology on overall response of DP is investigated
- Effects of both elongated and equiaxed particles on strength and ductility are investigated
- Elongated and interconnected martensite particles significantly increase the ductility
- The morphology of the martensite phase in DP steels impacts more the ductility than strength

Abstract

Strong and ductile dual-phase (DP) steels are an important class of advanced high strength steels that are commonly used by the automotive industry. Micromechanical computational modeling is imperative for guiding the material design of DP steels with simultaneous enhancements in strength and ductility. In this study, the effect of the morphology of the martensite hard phase on the overall stress-strain response of DP steels is studied. Through generating realistic virtual representative volume elements (RVEs) and adapting a microstructural-based approach using a finite deformation elastic-viscoplastic constitutive model, it was possible to conduct various parametric studies of the effects of martensite phase on the strength and ductility of DP steel. Morphological parameters of the martensite phase that are studied include (1) effect of aspect ratio (equiaxed versus elongated), (2) effects of the combination of various aspect ratio within an RVE, and (3) effect of interconnectivity between martensite particles and its thickness. It is